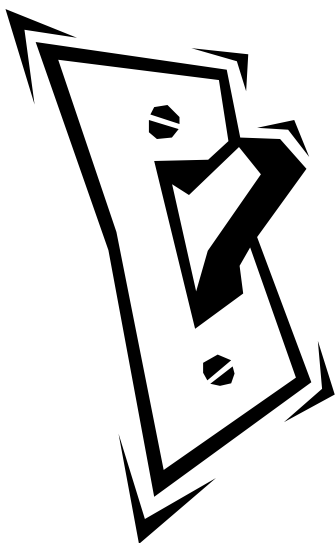


## Specifications for Lightning Protection — ASAE Engineering Practice



ASAE safety standards are not laws. They are recommended voluntary standards used by designers, engineers, manufacturers and users of the equipment, systems and products. However, in the absence of laws, rules and regulations, ASAE standards can be considered "best safety management practices," and failure to implement and enforce these standards could be interpreted as NOT providing a safe and healthy workplace. Manufacturers, employees and others have been found to be negligent when injury or death has resulted from noncompliance with a recognized ASAE Standard.

The standard is not included in its entirety in this document, but rather those safety and health concepts most pertinent to agricultural owners, managers, supervisors and workers have been selected. Complete copies of the ASAE Standards are available from ASAE Order Department, 2950 Niles Road, St. Joseph, MI 49085-9659, Telephone: (616) 429-0300, FAX: (616) 429-3852.

### Introduction

This is a condensation of American Society of Agricultural Engineers (ASAE) Standard EP381.1. It contains safety recommendations for lightning protection on farms. This document is not intended to be totally inclusive, but rather to highlight the information that owners and managers of agricultural businesses should understand.

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and Biological Engineering,  
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Developed by the Florida  
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Service for the benefit of  
Florida's citizens.

### Purpose and Scope

This Engineering Practice is intended as a guide for specifying farm lightning protection systems, and for checking existing, new or proposed lightning protection systems against accepted standards of design, materials and installation.

This Engineering Practice is applicable to protection of farm homes, barns, sheds, silos, slatted floors, fences, trees, barn

equipment and other sizable bodies of conductance or inductance. Included are ordinary structures up to 75 feet high.

Common assemblies on typical buildings are detailed to show current practices under normal conditions. Examples cannot cover the wide range of structural variations existing on farms. It is recommended that when a condition is not covered herein, the owner or his agent obtain engineering consultation by an engineer experienced in lightning protection principles, theories and installation requirements, or from an established and recommended manufacturer or distributor of lightning protection materials and equipment.

“Materials for lightning protection shall be inherently resistant to corrosion or properly protected against corrosion.”

In areas not covered by this Engineering Practice, refer to the National Fire Protection Association Standard No. 78, Lightning Protection Code; Underwriters' Laboratories Standard, Requirements for Master Label Lightning Protection; or Lightning Protection Institute Standard LPI-175, Installation Code.

## Materials

Materials for lightning protection shall be inherently resistant to corrosion or properly protected against corrosion. No materials shall be combined which form an electrolytic coupling that accelerates corrosion, such as copper-aluminum couplings.

Copper commonly required for commercial electrical work, with 98% conductivity when annealed, is the preferred material for farm lightning protection. Alloyed metals used shall be substantially as resistant to corrosion and have the same conductivity as copper under similar conditions.

Copper-clad steel shall have a copper covering permanently and effectively welded to the steel core, in such proportions that conductance is not less than 30% of the conductance of an equivalent cross section of solid copper.

Aluminum is acceptable as a substitute for copper in lightning protection, with the stipulations that (a) aluminum shall not be used underground, in contact with ground or where air may be laden with corrosive elements, such as ocean air; (b) when an aluminum system is joined with copper or copper-clad grounds, the union shall be made with approved bimetal connectors; (c) precautions be taken at connections with dissimilar metals; and (d)

cable conductors be of electrical conductor grade aluminum.

Material such as galvanized steel is not acceptable except as specified elsewhere in this Engineering Practice.

Materials shall be used in those forms and sizes specified in the following Sections, Air Terminals, Conductors, Grounding, and Connectors and Other Fittings.

## Air Terminals

Air terminals are the topmost elements of the lightning protection system and are designed to intercept a direct lightning strike.



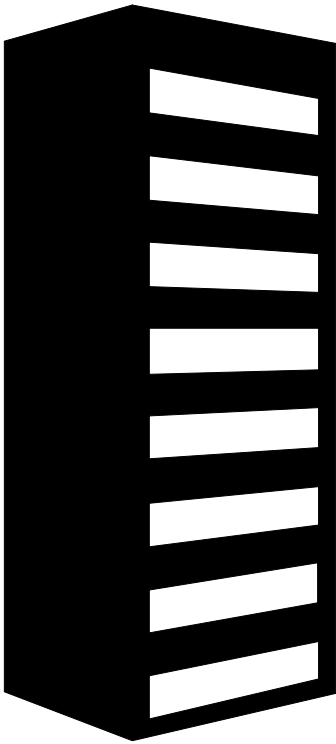
Air terminals shall be  $\frac{3}{8}$ -inch minimum diameter for solid copper or  $\frac{1}{2}$ -inch minimum for solid aluminum. Air terminals shall extend above the protected object at least 10 inches but no more than 36 inches. If over 24 inches high, air terminals shall be suitably braced.

Air terminals up to 24 inches high shall be spaced at intervals of 20 feet or less; those 24 inches or higher shall be spaced 25 feet or less. Terminals shall be placed on the ridges of gable, gambrel and hip roofs of ordinary or high slopes, and at the perimeters of flat or low-slope roofs. A shed roof with a high or normal slope shall be considered as half of a gable roof. There shall be an air terminal within two feet of the end of each ridge or each corner of a flat or low-slope roof.

Air terminals shall be placed within two feet of the edge along the perimeter of a flat or low-slope roof. A low-slope roof is one which is 40 feet wide or less and has a pitch of 1 in 8 or less; or is over 40 feet wide and has a pitch of 1 in 4 or less. The center of such a roof shall have intermediate air terminals at intervals not exceeding 50 feet.

Chimney air terminals may be anchored directly, or secured by an acceptable metal band around the chimney. No outside corner of a chimney shall be more than two feet from an air terminal. Copper chimney air terminals and all related components shall be hot-dip lead coated to prevent corrosion. Aluminum points, cable and fittings on chimneys need not be lead coated.

## Conductors



Main conductors are those used to (a) interconnect air terminals in a direct or closed-loop roof system; (b) serve as downleads from the roof system to the ground system; (c) connect metal bodies of inductance or conductance to the main conducting system; and (d) serve as ground electrodes in some cases, or to connect ground rods in certain other cases.

When there is no alternative to coursing a conductor through the air, this may be done without support for a distance of three feet or less, or with support of a  $\frac{5}{8}$ -inch copperclad ground rod or its equivalent. A conductor may be coursed through the air for a distance of up to 6 feet.

Roof conductors shall be coursed through or around obstructions in a horizontal plane with the main conductor. Conductors shall maintain a horizontal or downward course, free from U or V (down and up) pockets. No bend of a conductor shall form an angle of less than 90 degrees, or have a radius of bend less than 8 inches.

Metal roofing and siding, eave troughs, downspouts and other metal parts are not acceptable as substitutes for lightning conductors. A lightning conductor system shall be applied to the metal siding of a metal-clad building in like manner as on buildings without such metal coverings.

Down conductors, which are continuations of roof conductors, shall be as widely separated as possible at diagonal corners of rectangular buildings, and diametrically opposite on cylindrical structures.

No less than two down conductors with a proper ground for each shall be provided on any structure. Buildings with perimeters exceeding 200 feet shall have one additional down conductor for each 100 feet or fraction thereof.

Down conductors located in cattle yards, driveways or other vulnerable locations shall be guarded in such a manner as to prevent physical damage or displacement, to a distance not less than 6 feet above ground level. If run through conducting pipe or tubing (of compatible metal), the conductor should be bonded to the conduit at top and bottom.

“Proper grounds are critical to assure dissipation of a lightning discharge without damage.”

## Grounding

Proper grounds are critical to assure dissipation of a lightning discharge without damage. Extent of grounding will depend on the character of the soil, ranging from two simple 10 foot grounds for a small building located on deep conductive soil, to an elaborate network of cables and rods or plates buried in soil that is dry or rocky and of poor conductivity.

Minimum acceptable standard for each ground electrode shall be a copper-clad steel rod at least  $\frac{1}{2}$  inch in diameter and 10 feet long. Rods of solid copper  $\frac{1}{2}$  inch in diameter may be used in lieu of copper-clad steel. Stainless steel ground rods are also acceptable where acid soil conditions exist or other conditions warrant substitution of stainless steel.

Wherever practicable, connections to ground electrodes shall be made at points not less than one foot below grade and two feet out from the foundation. Grounds shall be distributed and placed at corners and other locations in a manner to direct the flow of current out from the building rather than under it. Placing of grounding under a building (as in extending a building) shall be kept at a minimum. There shall be a ground at each down conductor.

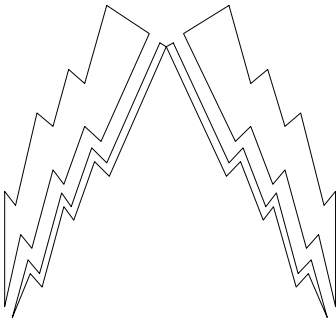
In moist clay, the ground shall extend vertically not less than 10 feet into the earth, and the earth shall be tamped along the full length of the ground.

In shallow top soil where bedrock is near the surface, the lightning conductor (extensions of the down conductors) shall be laid in trenches extending away from the building. Trenches shall be at least 12 feet long and one foot deep in clay soil, and at least 24 feet long and 2 feet deep in sandy or gravelly soil.

In moist sandy or gravelly soil of ordinary soil depth, 2 electrodes shall be driven at least 10 feet deep at each ground. The conductor shall be extended out from the building in a trench at least 2 feet from the wall. The two electrodes shall not be spaced more than 6 feet apart.

All underground metallic piping, including water piping, well casings, sewer and septic lines, shall be connected to the grounding system with main size conductors and special fittings with a

minimum contact surface to the pipe 1.5 inches long and 2 square inches area. Water pipe, well casings, sewer and septic line connections are in addition to the required number of regular grounds. If a metal water pipe, well casing, sewer or septic line enters a building, at least one down conductor of the lightning protection system shall be connected to it.



## Lightning Arresters

Radio and television masts of metal, regardless of location on a building, shall be bonded to the main conductor of the lightning protection system with a main-size conductor and acceptable fittings.

To protect radio or TV equipment against surges, a lightning arrester shall be installed on the lead-in wire, tape or cable and bonded to the lightning protection system directly or through a common ground. Secondary service arresters shall be installed by the lightning protection contractor, electrical contractor or the electric utility company. Such arresters shall be installed on both overhead and underground services at the electric service entrance, or at the interior service entrance box, depending on local regulations. Before installing a secondary service arrester, it should be determined that the neutral wire is adequately grounded, preferably to a metal water pipe system that enters the ground.

## Additional Resources

- Your County Extension office